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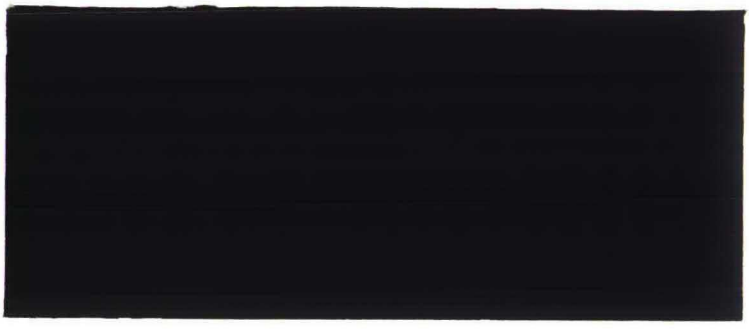

DEPARTMENT OF ECONOMICS

RESEARCH MEMORANDUM

ARE MANAGERS INDEED MOTIVATED BY THEIR BONUSES?

Harry G. Barkema

FEW 481

ARE MANAGERS INDEED MOTIVATED BY THEIR BONUSES?[1]

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Abstract

The evidence in this paper corroborates an important behavioral assumption of principal-agent theory: that agents are (indeed) motivated by their bonuses. A 1984 data set is examined of 131 managers of the computer and electronics-industry in the Netherlands. I find that these managers are positively and significantly motivated by their bonuses, even after potentially confounding tax and signalling effects and the sensitivity of the manager's bonus for his effort are explicitly statistically controlled for. However I also find that the magnitude of work incentives from bonuses is small: on average these managers are induced to less than two additional hours of work per week by their bonus.

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ARE MANAGERS INDEED MOTIVATED BY THEIR BONUSES?

Harry G. Barkema

1. Introduction

During the last decade, principal-agent theory has become a major development in economics.[1] It now constitutes the core of much modern theory in accounting, but also in organization theory and finance.

Unfortunately, until today, there is no unambiguous empirical support for one of the main behavioral assumptions of this theory: that agents are (indeed) motivated by their bonuses. A number of empirical studies has measured a positive relation between the size of the managerial bonus and various measures of firm performance (Larcker, 1983, Coughlan and Schmidt, 1985, Benston, 1985, Tehranian and Waegelein, 1985, Brickley, Bhagat and Lease, 1985, Murphy, 1985, 1986). In itself this evidence is consistent with the agency 'story' that bonuses motivate managers to improve firm performance. However it is well known that this evidence is ambiguous, since it can also be explained by other hypotheses (see Miller and Scholes, 1982, Hite and Long, 1982, Warner, 1985, Raviv, 1985, and Bhagat, Brickley and Lease, 1985).

First, the evidence can also be explained by a tax story. Miller and Scholes (1982) argue that 'bonus schemes' allow the firm to defer salary payments and to invest this salary on behalf of the manager during the deferral. This strategy allows tax benefits, because during the deferral corporate taxes are paid over the proceeds of the investment instead of the (usually higher) personal taxes that the manager has to pay if he invests his salary himself. So the Miller and Scholes tax story can explain the existence of bonus schemes, and hence the documented positive relation between bonuses and firm performance.

Secondly, the evidence can be explained by a signalling story. A signalling story assumes that managers may possess inside information or 'good news' that they wish to signal to the market. One way to convince the market of the truth of the signal is to adopt incentive schemes that reward management in case the good news is true. To give an example: managers may accept a scheme that awards bonuses to them dependent on future firm performance, thus signalling to the market that they expect a favorable outcome of investment projects (Ross, 1977, Leland and Pyle, 1977). So a signalling story can also explain that bonuses are related to firm performance.[2]

Thirdly, principal-agent theory assumes that the agent's pay is sensitive to his effort or, more precisely, that the compensation of agents is contingent on performance measures that are a stochastic function of their effort. To give an example: compensation contracts may award bonuses to managers conditional on the firm's profit or other firm performance measures. This contract structure alone could account for the measured positive correlation between bonuses and firm performance. This correlation does not necessarily mean that managers are motivated by their bonuses.

So at present there is no sound evidence in the compensation literature that supports that managers are indeed motivated by their bonuses.[3] In fact Jensen and Murphy find, from a data set of 2,213 US CEOs, such a weak pay-performance sensitivy that they believe that these managers are at most weakly motivated by their pay (Jensen and Murphy, 1990). This result is not without interest. If in practice managers are not - or at most weakly - motivated by their pay then the relevance of much of principal-agent seems limited.

The present paper provides a new methodology to test whether managers are motivated by their bonuses. Contrary to previous studies, that examine the relation between bonuses and various measures of firm performance, this study directly measures the effect of the manager's bonus on his individual effort. This effect is measured in such a way that other above mentioned effects: tax and signalling effects and the sensitivity of the manager's bonus for his effort, are explicitly statistically controlled.

The methodology in this paper is based on recent principal-agent theory in Holmstrom and Milgrom (1987, 1990). In the Holmstrom and Milgrom framework, a rational manager allocates his limited atten-

tion over various activities (work, family, recreation, etc.), dependent on the relative private costs and gains associated with these activities. As in other principal-agent theory, bonuses serve the purpose of rewarding productive work, and are expected to increase the attention that the manager devotes to work. Holmstrom and Milgrom define the attention that the manager devotes to work in terms of the time that he devotes to work. Hence bonuses are expected to increase the amount of (his limited) time that the manager devotes to work.[4]

Based on this theory, a non-recursive econometric model is specified that contains both the effect of 'bonus' on 'working time' and the reverse effect of 'working time' on 'bonus'. It is shown in the paper that the former effect captures the hypothesized agency effect that the manager is positively motivated by his bonus, and that the second effect captures both 1) the sensitivity of the manager's bonus for his effort; and 2) tax and signalling effects. So this model allows a test of whether managers are motivated by their bonuses, in such a way that tax and signalling effects and the sensitivity of the manager's bonus for his effort are explicitly statistically controlled.

The model is estimated on a 1984 data set of 131 functional managers (financial managers, marketing managers, etc.) of the computer and electronics-industry in the Netherlands.[5] All these managers are ranked directly below general management. The reason for analyzing a data set of managers that are homogenous in rank and industry is to mitigate omitted variables-problems.[6] This still leaves potential omitted-variables associated with firm size, because even within one industry firm size may differ substantially. However subsequent testing reveals that 'firm size' does not cause problems in the present study. Furthermore, 'working time' is operationalized by what seems a natural indicator of this variable: the number of hours that the manager works per week.

Estimation by means of LISREL's Maximum Likelihood-procedure leads to the following results. Positive, significant effects are measured both from 'bonus' on 'working time' and from 'working time' on 'bonus'. The measurement of the former effect means that even after tax and signalling effects and the sensitivity of the manager's bonus for his effort are explicitly statistically controlled for, I still find that managers are positively and significantly motivated by their bonuses. So the empirical results corroborate the agency assumption that managers are (indeed) motivated by their bonuses.

The measurement of the second effect: of 'working time' on 'bonus', is also interesting in itself. It is

consistent with the agency assumption that the manager's bonus is sensitive to his effort, that is, that at least part of the manager's compensation is contingent upon informative measures of his effort. However it is also consistent with tax and signalling hypotheses.[7]

In addition, I find that the **magnitude** of the work incentives from bonuses is small: on average less than 2 of the 48 hours that these managers work per week (4 % of their total working time) are induced by their bonuses. This conclusion is similar to Jensen and Murphy's 1990 conclusion about US CEOs: that these managers are at most weakly motivated by their pay. This similarity in conclusions about US CEOs and about dutch functional managers suggests an interesting hypothesis: that the weak work incentives from pay packages is a general phenomenon, that consistently occurs across managerial ranks, across firms and industries, and across cultures, such as North America and Europe. Future empirical research will provide additional insight in this respect and is encouraged.

Both the results of the Jensen and Murphy-study and of the present study support the intuition in Baker et al. (1989) that observed wage contracts often induce weak work incentives in order to keep managers from focusing too narrowly on aspects of their performance to which the bonus is tied. A formal analysis of this issue has recently been developed in Holmstrom and Milgrom (1990). Holmstrom and Milgrom show in this paper that muted incentives from bonuses can be optimal in settings where agents have multiple tasks and some tasks are difficult to observe. Empirical results such as in Jensen and Murphy (1990) and in the present study indicate that such new principal-agent theory is more productive in explaining observed pay packages and behaviour of managers than traditional single task ('effort') principal-agent models that suggest strong incentives from pay packages (Holmstrom, 1979, Shavell, 1979, etc.).

Furthermore, I find that various model parameters, including the significance of the incentive effect and various measures of the model fit, are improved if it is explicitly modelled that managers are risk averse. This support for the risk aversity assumption adds to previous empirical results in Lambert and Larcker (1987) on this issue. Even more significant effects are measured if, instead of the Maximum Likelihood-procedure, LISREL's recently developed Weighted Least Squares-procedure is used that does

not require that observed variables are normally distributed. The latter procedure is used after it is observed that the variable 'bonus' is highly skewed.

Finally, I also develop some theory about cross sectional variations in the size of the bonus of functional managers. From Holmstrom and Milgrom (1987, 1990) the hypothesis is derived that marketing and sales managers earn higher bonuses than other functional managers, because principals obtain more precise information about the actions of the former managers than about other functional managers: in terms of the number of products sold during the last month or quarter, in the form of changes in the number of products sold during the last advertisement campaign, and so on. A detailed empirical analysis of the homogenous group of marketing managers, which controls (statistically) for potentially confounding tax and signalling effects and differential labour market conditions for these managers, provides weak support for this 'precision of information'-hypothesis.

The development of theory about pay packages and behaviour of managers below the rank of CEO seems interesting in its own right. At present there is no well developed theory to explain the complex pattern of compensation contracts and associated behaviour in firms (Baker et al., 1989). Some theory exists on how compensation contracts of CEOs are shaped (Murphy, 1985, Antle and Smith, 1986, Jensen and Murphy, 1990) and how these contracts vary across firms and industries (Lambert and Larcker, 1987, Lewellen et al, 1987). However explanations of the shape of compensation contracts of managers below the rank of CEO are virtually missing.[8]

This paper is structured as follows. The precision of information-hypothesis about variations in bonuses across functional managers is developed in section 2. This section also introduces elements of the Holmstrom and Milgrom framework, on which the methodology of this paper is based. This methodology is presented in section 3. Section 4 contains a description of the data set and section 5 contains empirical results. The paper ends with some conclusions and suggestions for further research.

2. Theory

In this section I derive hypotheses about cross sectional variations in the size of the bonus of functional managers. This theory complements existing theory on cross sectional variations in pay packages within firms, such as Smith and Watts (1982) and Brickley and Dark (1987).

Consider the following setting: a publicly owned firm with a board of directors and multiple managers.[9] The board - as the principal - is assumed to maximize the value of contracts with managers.[10] Recent theory in Holmstrom and Milgrom (1987) implies that the board offers a linear compensation rule $w(x) = Ax + b$, where x is the information signal about the manager's attention or time devoted to work, and b the intercept which only serves to allocate the total certainty equivalent between the two parties. Ax can be interpreted as the manager's bonus and b as his salary. Holmstrom and Milgrom show that the efficient A satisfies $A = p / (1 + rs^2C'')$, where p is the expected gross profit from time devoted to work, s^2 is the variance of the signal, r is the agent's absolute risk aversion and C is his personal cost function (cost of effort).

This theoretical result can be used to predict variations in the size of the bonus across functional managers, given that more precise information seems available about the actions of e.g. marketing managers and sales managers than about other functional managers. This information about marketing and sales managers consists of the number of products sold during the last month or quarter, the increase in the number of products sold during an advertisement campaign, and so on. Furthermore, these observables are easily compared with those of other marketing and sales managers in the same industry. This comparison is informative about common external factors, which leads to even more precise information about the individual actions of these managers (see Lazear and Rosen, 1981, Holmstrom, 1982, Antle and Smith, 1986). In contrast less precise information seems available about other functional managers, such as R&D-managers, since the outcome of research activities often becomes clear only (many) years later, or about personnel managers, whose effort to maintain and increase the quality of the work force is even hard to measure in a long term context.

Since the precision of the information about marketing and sales managers seems relatively high, the variance of the information signal about their effort (s^2) is expected to be relatively low. Hence, given the

above mentioned theoretical result in Holmstrom and Milgrom (1987), marketing and sales managers are expected to be subjected to higher As which, in turn, are expected to lead to higher levels of effort and to higher bonuses than in case of other functional managers.[11]

The prediction that marketing and sales managers earn bigger bonuses than other functional managers is in itself unsurprising. It is well-known from the popular press that these managers sometimes earn large bonuses. However in this paper I submit and test one possible explanation of why these managers earn bigger bonuses: because more precise information is available about their actions. This explanation is non-trivial since other hypotheses, including tax and signalling hypotheses and hypotheses about differential labour market conditions, can also explain that these managers earn bigger bonuses. This will be shown in the next section, that also describes the methodology of this study.

3. Methodology

In this section it is modelled that 1) managers are motivated by their bonuses; and 2) marketing and/or sales managers earn bigger bonuses than other functional managers because more precise information is available about their actions. The model is specified such that hypothesized tax and signalling effects and the hypothesized sensitivity of the manager's bonus for his effort are explicitly controlled for. Section 3.1 deals with agency hypotheses and section 3.2 with tax and signalling hypotheses.

3.1. Agency hypotheses.

I start with the hypothesis that marketing and/or sales managers earn higher bonuses because more precise information is available about their actions. This effect is modelled in figure 1 as follows. In the figure 'type of manager' is a dummy valued 1 in case of a marketing manager and 0 otherwise, and 'bonus' is the managerial bonus. (An analogous story applies in case of sales managers.) So a positive effect is expected from 'type of manager' on 'bonus'.

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please insert figure 1 here

Next I turn to the modelling of the hypothesized agency effect that agents are positively motivated by their bonuses. This modelling requires some insight into the mechanism of **how** bonuses motivate managers. The theory of section 2 implies that cet. par. a higher A selected by the principal at the beginning of the period, induces the agent to select higher levels of attention and time devoted to work during the period, resulting in a higher expected bonus Ax at the end of the period (both because A is higher and because x is expected to signal more effort).

So this theory implies that a higher A (higher marginal revenues for the agent from his effort) is expected to lead to more time devoted to work. My data set does not contain direct information about A, so I cannot directly measure the effect of A on the amount of working time. Therefore I operationalize A by the manager's bonus, where higher bonuses are expected to reflect higher As. This leads to the specification of the positive effect of 'bonus' on 'working time' in figure 1.

In view of the structure of compensation contracts, the manager's bonus is expected to be sensitive to his effort. Hence also the reverse effect of 'working time' on 'bonus' should be modelled in figure 1. However after the latter effect is explicitly statistically controlled for, I still expect to measure a positive effect of 'bonus' on 'working time', consistent with the agency assumption that agents are positively motivated by their bonuses.

3.2. Tax and signalling hypotheses.

Even if the above hypothesized effects are measured, this result can still be explained by other hypotheses, such as tax and signalling hypotheses. This is shown in some detail below, because tax and signalling hypotheses have drawn considerable attention in the literature, because they consistently pose problems in empirical studies on compensation schemes (see Miller and Scholes, 1982, Warner, 1985,

Raviv, 1985), and because they also cause problems in the context of the present study.

The reader may feel that some of the identified potentially confounding tax and signalling influences are somewhat 'theoretical' and are unlikely to occur in practice. If so, this strengthens one of the main empirical results of this paper: that absent confounding tax and signalling influences, it is found that managers are positively motivated by their bonuses. Nevertheless, as I will show below, even in the present study such tax and signalling influences cannot (completely) be excluded on theoretical grounds alone. Hence there is reason to conduct an empirical test that explicitly controls for such effects.

My discussion starts with tax hypotheses. In their 1982 article Miller and Scholes seek 'to distinguish schemes that seem intended mainly to share tax benefits from those, of greater interest to economists, that appear designed as incentives to make the real pie bigger'. They show that bonus plans may in reality be tax 'gimmicks', designed to reap tax benefits.[12] In essence these gimmicks allow the firm - instead of the manager - to invest the manager's savings such that corporate taxes are paid over the life of the investment instead of personal taxes. Miller and Scholes show that this strategy allows tax benefits if corporate taxes are lower than personal taxes. This condition was satisfied in the Netherlands in 1984, when the data that are analyzed in this paper were gathered. At that time, the dutch corporate tax rate was 0.43, while marginal personal tax rates for managers typically were 0.67 or 0.72.

It is easily shown that the Miller and Scholes tax story can also explain the existence of a positive correlation between 'working time' and 'bonus'. If managers increase their attention and working time, this may increase their income. Hence they are able to save more, which may lead to bigger salary deferrals (called bonuses) in order to reap bigger tax benefits. So a tax story can explain that more working time leads to bigger bonuses. This theoretical effect is (also) captured by the effect of 'working time' on 'bonus' in figure 1. Furthermore, a tax story can explain that marketing managers earn bigger bonuses than other functional managers. If labour market conditions allow marketing managers to negotiate higher wages than other functional managers (and the data in the next section indicate that they do), then marketing managers are able to save more and to reap more tax benefits through bigger bonuses. This hypothetical tax effect is modelled in figure 1 as follows. The hypothesis that marketing managers are able to negotiate higher wages is modelled by the positive effect of 'type of manager' on 'total

income'. The hypothesis that higher incomes lead to higher bonuses (through tax gimmicks) is modelled by the positive effect of 'total income' on 'bonus'.[13]

Also a signalling story can explain a positive correlation between 'bonus' and 'working time'. A signalling story assumes that managers may possess good news that they wish to signal to the market. One example of good news is that management has committed itself to a high level of effort, and one credible way to signal this to the market is to accept a scheme that awards bonuses to managers based on future firm performance. So a signalling story can explain that more working time leads to bigger bonuses. This hypothetical effect is (also) captured by the effect of 'working time' on 'bonus' in figure 1. Furthermore, a signalling story can also explain that marketing managers earn bigger bonuses than other functional managers. If marketing managers are able to negotiate higher wages and if they are decreasingly risk averse, a risky bonus imposes less disutility on marketing managers than on other managers. Hence it is less costly to signal by means of marketing managers, which may explain their higher bonuses. This effect is modelled in figure 1 as follows. The hypothesis that marketing managers earn higher wages is (also) captured by the positive effect of 'type of manager' on 'total income'. The hypothesis that higher incomes lead to higher bonuses through cheaper signalling is (also) captured by the positive effect of 'total income' on 'bonus'.

After the above mentioned tax and signalling effects are explicitly statistically controlled for, I still expect to measure: 1) a positive effect of 'bonus' on 'working time', consistent with the agency assumption that agents are positively motivated by their bonuses;[14] and 2) a positive direct effect of 'type of manager' on 'bonus', consistent with the precision of information-hypothesis. This measurement is carried out in the next sections.

4. Data

Data were obtained from a survey among managers in the high-technology sector, held in the Netherlands in 1984 (Dijkstra, 1985).[15] The data concern managers at the two highest management

levels of their firm: general managers and functional managers directly below general management, such as financial managers, marketing managers, and so on. The survey was carried out by means of questionnaires, with a follow-up by telephone if questionnaires were not returned in time. Eventually, 50 firms responded (20 % of the firms approached).[16] Most of these firms were subsidiaries of foreign firms, mainly from the US. The median age of the firms in the data set was 19 years, the median number of employees was 59, and the median sales were 17 million dutch guilders (roughly $ 10 million). So these firms are smaller than the firms that are generally analyzed in the compensation literature.

Although 'high-technology' indicates some homogeneity in industries, it still entails electro-technical firms, computer firms, chemical firms, engineering firms, and so on. Lewellen et. al. (1987) and Lambert and Larcker (1987) have found variations in the shape of compensation contracts across firms and industries. Therefore it seems appropriate to analyze a more homogenous set of industries. In this paper I only analyze managers employed at computer firms and electro-technical firms (n = 33). Table 1 lists all 162 managers employed at the two highest management levels of these 33 firms, classified according to their main function. This table also contains the mean and median bonuses and total compensation of these managers.

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please insert table 1 here

The following observations can be made from table 1:

* Table 1 reveals that the observed bonuses are small relative to the bonuses documented in previous empirical studies on compensation schemes. Mean bonuses of general managers and of functional managers amount to 17 % and 11 % of their salary, respectively, while the CEOs of the Jensen and Murphy-study earn bonuses that amount to 50 % of their salary. This difference is probably due to the fact that the firms in my data set are smaller than the firms in the Jensen and Murphy-study, and that my data set contains firms from Europe, where bonuses tend to be much smaller than in the US. Further-

more, it is calculated from the data set that the mean number of hours of work per week is 47.931, or almost 48 hours per week.[17]

* Since Adam Smith, economists believe that specialization of workers increases efficiency. Adam Smith himself believed that the degree of specialization is only limited by the size of the economy. In contrast, modern economists realize that increased specialization is costly, which limits the extent of specialization. This insight can be illustrated by the results of table 1. My data set contains all functional managers employed at 33 firms. Table 1 reveals that less than 25 % of these firms employ separate managers for sales, purchases, personnel, technical services and education & training. Apparently in many instances it is value maximizing to have one manager perform multiple management functions. Additional costs associated with hiring separate managers for each management function may be: higher average employment costs (due to non-trivial fixed costs of hiring managers, such as a company car, a company loan, and so on), higher internal coordination costs (because managers are only at work part-time) and costs that arise if relevant information is spilled over to other firms, where managers are employed for the rest of their time. Competitors could use such information strategically, which could severely hurt the firm's interests.

* Murphy (1985) observes for Fortune top 500 firms that bonuses increase in managerial rank. The results of table 1 suggest that "Murphy's law" is quite general: the same regularity is found in the present study for much smaller, European firms.

* Table 1 reveals that, consistent with the precision of information-hypothesis, marketing managers (N = 26) earn higher bonuses than other functional managers at the same hierarchical level. However, as pointed out earlier, this empirical result does not necessarily support this hypothesis since tax and signalling hypotheses can also explain these higher bonuses. Table 1 also reveals that the data set contains only 7 sales managers. Closer inspection of the data reveals that these managers are primarily employed at larger firms. So it seems hard to generalize from this small subset and the test of the hypothesis about sales managers is left for future analysis.[18]

5. Empirical results.

This section contains empirical tests of the model of figure 1. Before the model is tested, several steps are taken to mitigate omitted variables-problems. Although empirical studies that examine cross sectional data are inherently subject to potential omitted variable-problems absent a theory indicating all relevant variables and data on these variables, it is nevertheless important to reduce such potential problems as much as possible. This is emphasized in the compensation literature in Murphy (1985). Given the importance of this issue, it is given more attention in the present paper than is usually done in empirical studies of compensation schemes that analyze cross sectional data.

This section is structured as follows. Potential omitted variables-problems are discussed in section 5.1. Section 5.2 contains a test of the model of figure 1. Section 5.3 contains a test of an extension of the model that also incorporates that managers are risk averse. Finally, it is tested in section 5.4 whether the estimation results are robust for dropping the assumption that observed variables are normally distributed.

5.1. Potential omitted variables-problems.

Murphy (1985), Lambert and Larcker (1987) and Lewellen et al. (1987) have observed that compensation packages vary across managerial rank, firms and industries. One way to mitigate associated omitted variables-problems is to analyze managers that are homogenous in rank and in industry. In the previous section I already mentioned the selection of managers of firms of the computer and electronics-industry from the more heterogenous high-technology sector. Since compensation contracts also vary across managerial rank (see Murphy, 1985), the homogeneity of the data set is further increased if only functional managers directly below general management are analyzed. So general managers are left out of the analysis.

This leaves potential omitted variables-problems associated with firm size, since even within one industry firm size may differ substantially. Omitted variables-problems associated with firm size occur if the size of the bonus correlates with other elements of the manager's pay package, such as his inside

stockholdings, and both the bonus and inside stockholdings correlate with his working time. Jensen and Murphy (1990), who also analyze managers of similar rank (CEOs), measure no significant relation between bonuses and inside stock holdings. However I analyze managers of a different rank: functional managers, hence it cannot completely be excluded that firm size causes omitted variables-problems in the present study. Whether 'firm size' correlates with both 'bonus' and 'working time' is tested below.

The data set contains two variables that operationalize firm size: the number of employees in the firm and the annual sales of the firm. Both variables are available in the data set at the ordinal level, ranging from 1 for the smallest category to 6 for the largest category. The variable 'working time' is operationalized by the number of hours that the manager works per week. The relevant correlation coefficients are given in table 2.[19] Table 2 reveals insignificant positive correlations between both measures of firm size and 'bonus', and insignificant negative correlations between both measures of firm size and 'hours of work'. So it seems that 'firm size' is neither related to 'bonus' nor to 'hours of work', and that it does not cause omitted variables-problems in this study. Furthermore, the high positive correlation between the number of employees in the firm and the annual sales of the firm (0.96) is an additional indication that the data set is homogenous in the technology of firms.

5.2. Estimation results of the model of figure 1.

The model of figure 1 is estimated on the data set of 131 functional managers. [20] As mentioned above, the theoretical variable 'working time' is operationalized by what seems a natural indicator of this variable: the number of hours that the manager works per week. The manager's bonus is operationalized as his total bonus dependent on performance measured at the corporate, divisional or individual level. His total income is salary + bonus + other elements (fixed yearly gratifications, compensation for expenses, and so on).

The model is estimated by means of LISREL, a flexible framework for econometric analysis. LISREL allows the simultaneous estimation of multiple equations, hence two-way relations can explicitly be modelled (Joreskog, 1973, 1977, Joreskog and Wold, 1981).[21] The model of figure 1 is represented in equation (1) where y_1 = the manager's total income; y_2 = his bonus; y_3 = hours of work; x_1 = type of

manager, a dummy valued 1 in case of a marketing manager and 0 otherwise; b_{ij} = the effect of variable y_j on variable y_i; g_{ij} = the effect from variable x_j on variable y_i; and z_i = the error associated with equati on i.

$$\begin{bmatrix} y_1 \\ y_2 \\ y_3 \end{bmatrix} = \begin{bmatrix} 0 & 0 & 0 \\ b_{21} & 0 & b_{23} \\ 0 & b_{32} & 0 \end{bmatrix} \begin{bmatrix} y_1 \\ y_2 \\ y_3 \end{bmatrix} + \begin{bmatrix} g_{11} \\ g_{21} \\ 0 \end{bmatrix} \begin{bmatrix} x_1 \end{bmatrix} + \begin{bmatrix} z_1 \\ z_2 \\ z_3 \end{bmatrix} \qquad (1)$$

Maximum Likelihood-estimates of the model of equation (1) are presented in table 3.[22]

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please insert table 3 here

The following conclusions can be drawn from table 3. Both effects from 'bonus' on 'hours of work' and from 'hours of work' on 'bonus' have the expected sign and are significant, assuming a one sided test and a 0.05 significance level (t = 1.75 and t = 2.03, respectively). So I find that managers are positively and significantly motivated by their bonuses, even if tax and signalling effects and the sensitivity of the manager's bonus for his effort are explicitly controlled for. Furthermore, the significant positive effect of 'hours of work' on 'bonus' is also interesting in itself. It is consistent with the agency assumption that the manager's bonus is sensitive to his effort. However it is also consistent with tax and signalling hypotheses.

Furthermore, an estimate can be made of the magnitude of the work incentives that the average functional manager derives from his bonus. The model estimates of table 3, combined with the average bonus of functional managers given in table 1, imply an average increase of (0.105)(9.554) = 1.003 hours, that is, roughly one hour of work per week. So the average functional manager appears to derive positive but weak work incentives from his bonus.

Table 3 also reveals that marketing managers earn significantly higher total incomes than other managers at the same management level (t = 4.69). These higher incomes lead to significantly higher

bonuses (t = 6.95). The last result is consistent with a tax hypothesis, or a signalling hypothesis, or both.[23] However I find that after these other non-mutually exclusive effects are statistically controlled for, marketing managers still earn significantly higher bonuses than other managers (t = 1.69). This is consistent with the precision of information-hypothesis.

5.3. The bonus as a portion of total income.

The model estimated in section 5.2 is incorrect if the manager's work incentives (that is, the effect from 'bonus' on 'hours of work') depend not so much on the absolute size of the bonus but on its relative size: the portion of total income that is at stake. So a bonus of, say, f 10.000 may provide stronger work incentives for a manager earning f 80,000.- than for a manager earning f 400,000.- This would be consistent with risk aversity: a common assumption of agency theory. This assumption is tested in the following way. I reestimated the model of figure 1 with, in stead of the variable 'bonus' the variable 'fraction', defined as the bonus / total income. The estimation results are presented in table 4.

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please insert table 4 here

Table 4 reveals that the effect of 'fraction' on 'hours of work' is more significant than the earlier measured effect from 'bonus' on 'hours of work' (t = 1.90 against t = 1.75 earlier). Also, the total work incentives from bonuses, calculated from table 3 and the average fraction of functional managers as 22.382 (0.089) = 1.991 hours per week, are almost twice as big as in case of absolute bonuses. Finally, I find that the explained portion of the variance of the number of hours that the manager works per week increases from 0.16 to 0.24. All these results suggest that the portion of the manager's income that is at stake, rather than his bonus per se, affects his effort. So these estimation results support the risk aversity assumption (see also Lambert and Larcker, 1987).

The effect of 'type of manager' on 'fraction' is significant at the 0.05 level, assuming a one sided test

(t = 1.65). The result that marketing managers earn higher fractions of their total income in the form of bonuses is, strictly speaking, a stronger result than the earlier found result that marketing managers earn higher bonuses, in view of the higher total wages of marketing managers. However the effect is only barely significant.

5.4. Observed variables are not normally distributed.

Classical theory of covariance structures (Browne, 1974, Joreskog, 1981) holds in particular if the observed variables have a multivariate normal distribution. The Maximum likelihood-method used above is also based on this theory. However, the results of table 1 suggest that the variable bonus is abnormally distributed since the median bonus of functional managers is much smaller than the mean bonus: f 3,100 and f 9,554 respectively. Additional calculations reveal that the skewness and the kurtosis of the observed bonuses are 3.615 and 16.321, respectively. Both measures are significant at the 0.001 level. Hence the hypothesis that the variable bonus is normally distributed is rejected. As a result previous estimates, e.g. of standard deviations and of chi-squares, may be biased.

The rest of this section contains a test of whether the estimation results of sections 5.2 and 5.3 are robust against dropping the assumption that observables are normally distributed. In Browne (1984) the theory for covariance structures is generalized to any multivariate distribution, resulting in the Weighted Least Squares method (WLS). This method is part of the most recently developed LISREL-framework: LISREL-VII. WLS-estimates of the model of figure 1 are presented in table 5. WLS-estimates of the model of figure 1 with 'bonus' replaced by 'fraction' are presented in table 6.

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please insert table 5 here

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please insert table 6 here

The following conclusions can be drawn if the WLS-estimates of tables 5 and 6 are compared to the ML-estimates of tables 3 and 4.[24] The effects of 'type of manager' on 'bonus' and on 'fraction' still have the expected sign but become insignificant (t = 1.34 and t = 1.16, respectively). Both interrelations between 'bonus' and 'hours of work' are more significant than in case of ML. In sum: the empirical support weakens for the precision of information-hypothesis, but strengthens for the assumption that managers are motivated by their bonuses.

6. Conclusions and suggestions for further research

This paper presents evidence from a 1984 data set of 131 functional managers of the computer and electronics-industry in the Netherlands. I find that these managers are positively and significantly motivated by their bonuses, even after potentially confounding tax and signalling effects and the sensitivity of the manager's bonus for his effort are explicitly statistically controlled for. However I also find that the magnitude of work incentives from bonuses is small: the average functional manager is induced to less than two additional hours of work per week by his bonus.

The conclusion that managers derive weak incentives from their bonuses is similar to the conclusion that Jensen and Murphy (1990) derive from their data set of US CEOs. This suggests that weak work incentives from compensation packages is a general phenomenon, that can consistently be found across different managerial rank, firms and industries, and different cultures, such as North America and Europe. Such weak incentives from compensation packages may contrast with the much stronger incentives that arise if managers are also major residual risk bearers, such as in intrepreneurial firms, in case of franchising, after management buy-outs, and so on. Future empirical research might lead to interesting insights in this respect and is therefore encouraged.

The above suggested more modest view on the economic relevance of pecuniary incentives (the 'sadder but wiser'-view) is consistent with recent comments on agency theory by Herbert A. Simon in a recent interview on current trends in Accounting: 'The problem I have with .. agency theory .. is that this theory seems to look almost entirely at economic inducements. This theory also seems to assume that leisure is such a desirable good that people are intrinsically shirkers and that they will only do what can be enforced. There is a tremendous amount of psychological evidence that contradicts this: human beings are not only capable of acquiring strong loyalties to organizations or organizational units, they are incapable of not acquiring them. .. People do all sorts of things for which they receive no reward. They don't just do the minimum they can do without getting caught.' (see the July 1990 issue of the Accounting Review, p. 658-667).[25]

Simon's point seems to be that utility functions of managers are differently shaped than is generally assumed in principal-agent theory: managers may highly value loyalty, perhaps also power and status, they may value their work ('effort') positively up to some level, and so on. As a result managers may select positive and even high levels of effort even if they earn fixed salaries, provided that they earn their reservation wage. This may provide a second explanation of why the optimal pay package induces weak work incentives, in addition to the earlier explanation that managers have multiple tasks and some tasks are difficult to observe. Interesting in this respect is that Holmstrom and Milgrom (1990) explicitly allow that managers derive positive utility from time devoted to work up to some level.

Finally, I also derived and tested hypotheses about cross sectional variations in the size of the bonus of functional managers. The hypothesis was derived that marketing and sales managers earn higher bonuses than other functional managers, because more precise information is available about their actions. An empirical analysis of marketing managers, that explicitly controlled for tax and signalling effects and differential labour market conditions, provided weak support for this 'precision of information'-hypothesis.

At present little knowledge exists in the compensation literature on how the compensation contracts of managers below the rank of CEO are shaped and what behaviour is induced by these contracts. It seems nevertheless important to develop such theory. Modern corporations often employ thousands and

sometimes hundreds of thousands of workers. The notion that the CEO controls all or most important decisions in the firm is consistent with an holistic point of view but not with the agency perspective of the firm as a nexus of contracts, where decision management and decision control are spread over multiple hierarchical layers in order to reduce information costs (Fama and Jensen, 1983). Additional insight into how the compensation contracts of managers below the rank of CEO are shaped may eventually lead to improved explanations of important decisions in the firm: the selection of investment projects, the adoption and use of accounting rules, the firm's merger and acquisition strategy, and so on.

Footnotes

1. For an overview, see Hart and Holmstrom (1987), and their more than 130 references.

2. A more cynical but perhaps more realistic view is that while its illegal for managers to trade on their inside information in the stock market, it is not illegal for them to adopt compensation policies that take advantage of unrevealed information. Managers with good news about next year's accounting returns might, for example, push through a short-run bonus plan which allows them to benefit from next year's performance. The market, observing the proposed bonus plan, will infer that managers think next year will be good.

3. Principal agent theorists have also argued that: 1) 'anecdotal evidence' supports that managers are motivated by their bonuses. However if anecdotes circulate in favor of an hypothesis, it is usually not difficult to find anecdotes against it; 2) laboratory experiments have shown that individuals, usually students, react positively to pecuniary stimuli. However it is not obvious that results that apply to cash-hungry students in laboratory settings also apply to managers in real life settings. Or as Burton and Obel, who conducted one of the more realistic experiments in this field, have put it: '(l)aboratory experiments have limited realism and external validity.' (Burton and Obel, 1988).

4. Obviously, time spend at work is itself not necessarily productive. However in the Holmstrom and Milgrom framework, rational managers subjected to compensation plans that reward productive work have, for the relevant domain of decisions, no incentive to spend additional time at work if this time is not made productive. To give an example: a manager working at friday night, who is only rewarded for productive work, has no incentive to spend an additional hour at work improductively if he can also spend this time with his family at home or with his friends on the golf links. Alternatively, if the manager is still able to be productive and if bonuses reward productive work, then the manager may decide to spend some additional time working.

5. Most of these firms are subsidiaries of foreign firms, mainly from the US.

6. That pay packages vary across managerial rank, firms and industries, is documented in Murphy

(1985), Lambert and Larcker (1987), and Lewellen et al. (1987).

7. That the measured pay for effort sensitivity can also be explained by tax and signalling hypotheses is not a unique aspect of this study. The positive pay performance sensitivity documented in Jensen and Murphy (1990) can also be explained by tax and signalling effects, although Jensen and Murphy do not mention such alternative explanations. Incidentally, these potentially confounding effects strengthen rather than weaken their conclusion that the CEOs in their data set are not 'significantly' motivated by their pay.

8. Exceptions are Smith and Watts (1982), Murphy (1985) and Brickley and Dark (1987).

9. A board may exist if the gains from monitoring managerial effort (Holmstrom, 1979, Shavell, 1979) and from screening projects initiated by managers (see Sah and Stiglitz, 1985, 1986) are larger than the cost of installing and maintaining the board. Apparently these gains often surpass the costs, in view of the board's survival in public corporations (Fama and Jensen, 1983).

10. So problems due to 'what if the principal is not the principal' are assumed away (Baker et al., 1989). Board members may be motivated because they own shares of the firm, because of proxy fights or takeover threats (possibly resulting in a removal of incumbent directors) or because their performance as a director affects their reputation and hence their income in other occupations: as a director or as a manager at another firm (Manne, 1965, Fama, 1980, Fama and Jensen, 1983, Jensen and Ruback, 1983, Jensen and Warner, 1988).

11. The result that marketing and sales managers earn higher bonuses than other functional managers can also be derived from more traditional agency theory. Lambert and Larcker (1987) show that if in addition to the setting assumed in Holmstrom (1979) it is assumed that the agent's utility function for money $U(c) = (1/(1-k)).c^{1-k}$ and, following Banker and Datar (1987), that the probability distributions are of the class of exponential, normal or binomial distributions (among others), it follows that:

$$[c(x,y)]^k = l + m(d_0 + g\{d_x[x - E(x|a)\} + d_y[y - E(y|a)]\}),$$

where x = the agent's output, y = other information about his effort, k = a constant, l,m are Lagrange

multipliers, $d_x = s(x|a)/var(x|a)$, and $d_y = s(y|a)/var(y|a)$. Hence c(x,y): the agent's compensation is increasing in d_x and d_y: the signal-to-noise ratios of the information signals of the agent's performance. Given higher signal-to-noise ratios for marketing and sales managers, these managers are expected to earn higher compensation or higher bonuses.

12. Miller and Scholes obtain similar conclusion for other 'incentive' schemes, including various types of stock (restricted stock, phantom stock, performance shares) and options (option stock, appreciation rights, stock purchase plans).

13. A positive effect could also be modelled of 'bonuses' on 'total income' because total income = salary + bonus + other elements. I will come back to this later.

14. Even if direct information about A would have been available and the effect of 'A' on 'working time' could have been modelled instead of the effect of 'bonus' on 'working time', still the reverse effect of 'hours of work' on A should have been modelled in order to control for tax and signalling effects. So even if direct information about A is available, there is still reason to specify and estimate a non-recursive model.

15. High-technology firms were defined in terms of R&D-expenditures (above industry average), OESO-specialization coefficients, and so on. Only firms with more than 10 employees were selected (Dijkstra, 1985).

16. Since the non-response rate was quite high (80 %), tests were carried out to check for response bias, e.g. a chi-square test was carried out on the types of industries that responded: electro-technical firms, computer firms, chemical firms, engineering firms, and so on. No significant scores were found.

17. The number of hours per week is obtained from self-reporting of managers. Since this information is given in the context of anonymous questionnaires, managers have no incentive to signal false information about their effort.

18. If anything, though, the bonuses of sales managers of table 1 do not suggest that the precision of

available information is a factor that dominates all other factors that affect the size of the bonus.

19. In case one variable was measured on at least interval level (such as the bonus) and the other variable on the ordinal level (such as the number of employees) the table gives the polyserial correlation because this correlation exploits the interval properties of the first variable. Alternatively, a rank order correlation could have been calculated. However in that case information would have been 'thrown away' because both variables are treated as ordinal, and an insignificant correlation could have been measured even if 'in reality' the correlation is significant.

20. An alternative way to check for omitted variables-problems is to include variables that may cause problems, such as firm size, in the empirical model. However since the variables that operationalize firm size are measured at the ordinal level, an empirical model could only have been estimated from a correlation matrix (that includes polyserial correlations) and not from a covariance matrix. Such estimates from a correlation matrix would have been informative about the econometric significance of effects but not on the magnitude of effects, that is, on their economic significance. However in this paper I am also interested in the economic significance of effects.

21. For an introduction to LISREL, see Barkema and Folmer (1983).

22. The covariance matrix of the random disturbances in the structural equations is assumed to be diagonal. The model could also have been estimated by e.g. 2SLS. Since these estimates are virtually identical, they are omitted here.

23. It is easy, though, to imagine other hypotheses that can also explain the positive relation between 'total income' and 'bonus', such as that it is less costly to induce risky bonuses on managers with higher incomes. Furthermore, an additional effect of 'bonus' on 'total income' could be modelled since, by definition, total income = salary + bonus + other elements. This model was also estimated but since the estimation results do not affect above conclusions in any way, they are omitted here.

24. These estimates have to be interpreted with some care because the small sample properties of WLS are somewhat unexplored yet. Although N = 131 is not really a small sample, some care is in order.

25. Interestingly, the latter claim is consistent with the result in the present study that even in the absence of bonuses, managers work on average 46 hours per week. However this result can also be explained as a result of other incentive mechanisms such as inside stock ownership and discipline from labour markets.

Figure 1.

A theoretical model that explicitly separates hypothesized agency effects from hypothesized tax and signalling effects. 'Type of manager' is a dummy valued 1 in case of a marketing manager and 0 otherwise; 'total income' = salary + bonus + other elements.

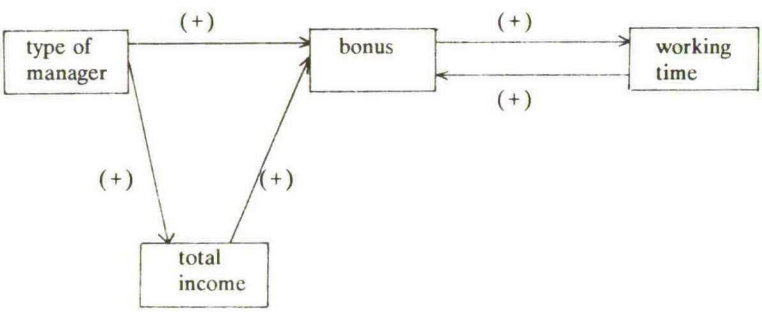

Table 1.

Bonuses, salaries and total income of managers (N = 162) of the two highest management levels of a 1984 sample of 33 dutch firms from the computer and electronics-industry. Managers are classified according to their main management function. The bonus is the manager's total bonus dependent on performance at the corporate, divisional or personal level, total income = salary + bonus + other income. Bonuses, salaries and total income are in dutch guilders.

	bonus		salary		total income		
	mean	median	mean	median	mean	median	N
General managers	23,025	11,000	136,233	123,000	172,714	160,000	31
Functional managers	9,554	3,100	86,469	83,000	106,938	104,000	131
Finance and admin.	5,441	0,000	82,290	78,000	98,409	102,300	22
Production	8,482	3,300	82,953	81,000	102,382	100,000	33
Marketing	21,917	6,990	103,515	98,000	138,688	128,000	26
Personnel	8,514	6,000	91,429	83,000	110,857	107,000	7
Purchases	4,431	3,820	72,157	67,100	83,500	77,500	7
Automatization	3,222	0,000	88,444	75,000	103,222	82,000	9
Sales	4,488	1,000	83,143	94,000	102,187	113,000	7
R & D	7,119	0,000	87,654	83,000	102,662	88,000	13
Technical services	3,700	3,900	65,720	69,000	77,000	77,000	5
Education & training	10,000	10,000	48,500	48,500	67,500	67,500	2

Table 2.

Correlation coefficients from a 1984 sample of 131 functional managers of the computer and electronics-industry in the Netherlands. The variable 'hours' is the number of hours that a manager works per week, 'bonus' is the manager's bonus dependent on performance at the corporate, divisional or individual level, 'employees' is the number of employees of the firm where the manager is employed, 'sales' is the annual sales of the firm where the manager is employed.

	hours	bonus	empl.	sales
hours	1.000			
bonus	0.442 (0.000)	1.000		
employees	-0.035 (0.689)	0.092 (0.298)	1.000	
sales	-0.053 (0.550)	0.125 (0.156)	0.957 (0.000)	1.000

Note - Prob. values of the hypothesis that the corresponding correlation coefficient is 0 are given in parentheses. The variables 'employees' and 'sales' are available in the data set at the ordinal level. A Pearson correlation coefficient was calculated if both variables were at least on an interval level, polyserial correlations were calculated if one variable was at least on an interval level and the other variable was at the ordinal level, and a polychoric correlation was calculated if both variables were at the ordinal level.

Table 3.

LISREL Maximum likelihood-estimates from a 1984 sample of 131 managers of the computer and electronics-industry in the Netherlands. 'Type of manager' is a dummy, valued 1 in case of a marketing manager and 0 otherwise; bonus is the total bonus dependent on performance at the corporate, divisional and individual level; 'total income' = salary + bonus + other elements; 'hours of work' are hours worked per week. T-values are given in parentheses.

	Dependent variable		
	total income*	bonus*	hours of work
Independent variable			
type of manager	39.612 (4.69)	5.398 (1.69)	-
total income*	-	0.218 (6.95)	-
bonus*	-	-	0.105 (1.75)
hours of work	-	0.518 (2.03)	-
R^2	0.146	0.456	0.155

*) total income and bonuses are in thousands of dutch guilders. R^2 is the squared multiple correlation for the structural equations. The chi-square for the whole model with 1 degree of freedom = 0.71 ($p = 0.40$). The Goodness of Fit Index ($0 \leq GFI \leq 1$) for the model is 0.997.

Table 4.

LISREL Maximum likelihood-estimates from a 1984 sample of 131 managers of the computer and electronics-industry in the Netherlands. 'Type of manager' is a dummy, valued 1 in case of a marketing manager and 0 otherwise; 'fraction' is the total bonus dependent on performance at the corporate, divisional and individual level divided by 'total income'; 'total income' is salary + bonus + other elements; 'hours of work' are hours worked per week. T-values are given in parentheses.

	Dependent variable		
	total income*	fraction	hours of work
Independent variable			
type of manager	39.612 (4.69)	0.0330 (1.65)	-
total income*	-	0.000965 (4.86)	-
fraction	-	-	22.382 (1.90)
hours of work	-	0.003923 (1.94)	-
R^2	0.146	0.411	0.242

*) total income is in thousands of dutch guilders. R^2 is the squared multiple correlation for the structural equations. The chi-square for the whole model with 1 degree of freedom = 0.56 (p = 0.45). The Goodness of Fit Index ($0 \leq GFI \leq 1$) for the model is 0.998.

Table 5.

LISREL Weighted Least Squares-estimates from a 1984 sample of 131 managers of the computer and electronics-industry in the Netherlands. 'Type of manager' is a dummy, valued 1 in case of a marketing manager and 0 otherwise; bonus is the total bonus dependent on performance at the corporate, divisional and individual level; 'total income' = salary + bonus + other elements; 'hours of work' are hours worked per week. T-values are given in parentheses.

	Dependent variable		
	total income*	bonus*	hours of work
Independent variable			
type of manager	40.706 (4.11)	5.305 (1.34)	-
total income*	-	0.220 (4.56)	-
bonus*	-	-	0.103 (2.29)
hours of work	-	0.521 (2.26)	-
R^2	0.153	0.456	0.157

*) total income and bonuses are in thousands of dutch guilders. R^2 is the squared multiple correlation for the structural equations. The chi-square for the whole model with 1 degree of freedom = 0.51 (p = 0.48). The Goodness of Fit Index ($0 \leq GFI \leq 1$) for the model is 0.997.

Table 6.

LISREL Weighted Least Squares-estimates from a 1984 sample of 131 managers from the computer and electronics-industry in the Netherlands. 'Type of manager' is a dummy, valued 1 in case of a marketing manager and 0 otherwise; 'fraction' is the total bonus dependent on performance at the corporate, divisional and individual level, divided by 'total income'; 'total income' = salary + bonus + other elements; 'hours of work' are hours worked per week. T-values are given in parentheses.

	Dependent variable		
	total income*	fraction	hours of work
Independent variable			
type of manager	40.461 (4.07)	0.0314 (1.16)	-
total income*	-	0.000991 (4.43)	-
fraction	-	-	21.65 (2.34)
hours of work	-	0.003878 (2.03)	-
R^2	0.151	0.407	0.235

*) total income is in thousands of dutch guilders. R^2 is the squared multiple correlation for the structural equations. The chi-square for the whole model with 1 degree of freedom = 0.43 (p = 0.51).

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